Sunny Boy and Sunny Mini Central Solar Inverters for Photovoltaic Plants

Operating Instructions | Version 1.8 | SB_SMC-BEN073618
TBE-ALL

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1 Foreword

Warning!

The Sunny Boy and Sunny Mini Central may only be installed by trained specialists. Installation engineers must be approved by the local energy supplier.

Please read the installation manual thoroughly. All prescribed safety regulations, the technical connection requirements (TCR) of the local energy supplier and all VDEW regulations must be adhered to.

With the purchase of a Sunny Boy or Sunny Mini Central, you have decided on a technically mature device, which is currently the most advanced modular PV system technology available for connecting photovoltaic systems to the grid. SMA inverters distinguish themselves particularly by means of their high levels of efficiency and reliability. These inverters comply with all the VDEW (Verband der Elektrizitätswirtschaft – German Electricity Industry Association) regulations for the connection and parallel operation of electrical power units to the low-voltage grid of the electricity supply company. This also encompasses the regulations of the German Professional Association for Precision Engineering and Electrotechnology relating to "Automatic switching of electrical power units" and/or DIN VDE 0126. In addition to this, the inverter conforms to the electromagnetic tolerance regulations and the low-voltage regulations of the relevant combined European norms, as confirmed in the CE conformity declaration.

1.1 Target group

This documentation is intended for the operator of the system. The documentation provided here primarily covers such topics that are of interest when operating the inverter. In addition to explanations of the operational methods of the device, advice as to data capture and analysis is also provided.

Information relating to the installation and commission of the inverter should be taken from the installation manual delivered with the device. The installation manual also contains detailed device-specific technical data.

1.2 Explanation of the symbols used:

To ensure optimum use of these instructions, please note the following explanation of symbols used.

This symbol identifies an example.

This symbol identifies a notice where failure to follow the advice will make the procedure or operation more difficult.

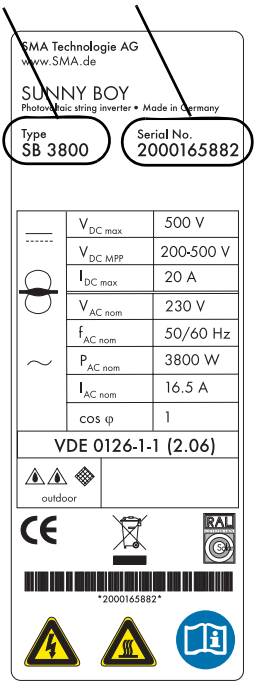
This symbol indicates a fact that when not observed could result in damage to components or danger to persons. Please read these sections especially carefully.

1.3 Identification of the inverter

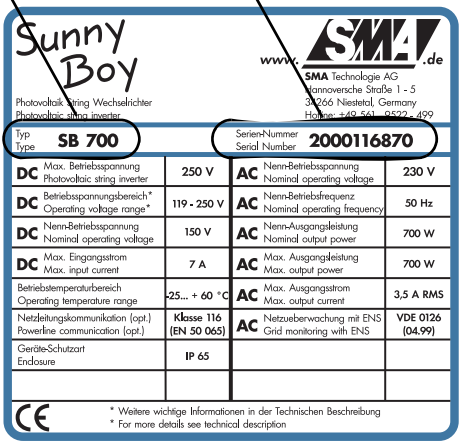
You can identify the inverter with the aid of the type plate (see figure below). The type plate is usually found on the right-hand side of the enclosure (when viewed from the front). On the Sunny Boy SB 2800i and the Multi-String devices, the type plate is found on the underside of the device. The type plate contains information regarding the device type, serial number, device-specific key data, the CE mark and SMA contact information.

The following is an example of a Sunny Boy SB 3800 and Sunny Boy SB 700 type plate.

Device Type Serial Number



Device Type Serial Number



2 Safety instructions

Opening of the inverter, and any

- **electrical installation,**
- **repair or**
- **modification**

of the inverter may only be performed by qualified electrical personnel. Even when no external voltage is present, the device can still contain high voltages.

Danger of death! Dangerous high voltages may be present.

The temperature of individual parts of the enclosure of the inverter - in particular the temperature of the heatsink(s) - can reach a temperature of over 60 °C in normal operation. There is the danger of burn injury when these parts are touched!

Overvoltages lead to the destruction of the inverter, thereby voiding all warranty claims.

Please contact your installer if the inverter emits a blink code or a display message as described in section 4.4.12 "Input voltage (PV generator) too high" (Page 27) or 5.3.2 "DC overvoltage" (Page 33).

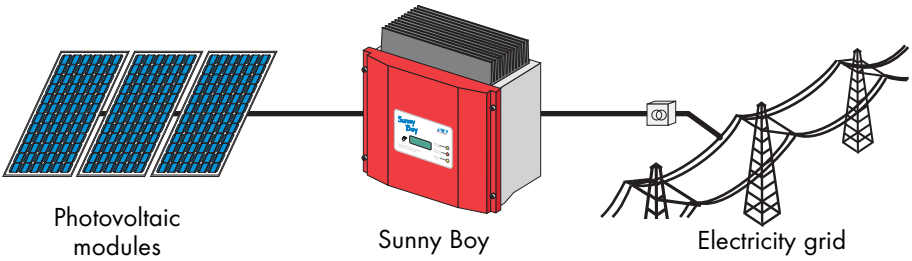
3 Unit description

3.1 Appropriate usage

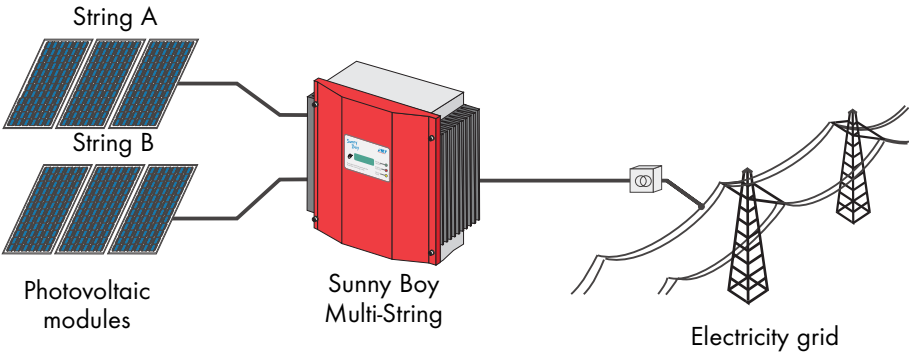
The Sunny Boy / Sunny Mini Central allows photovoltaic solar energy to be converted and fed into a 220 - 240 V 50 Hz low voltage grid. Some SMA inverters can also be operated on a 60 Hz grid. More precise information on this subject and on your device can be found in the installation manual. The operational limits specified in the installation manual for the particular inverter must be observed.

Do not use the Sunny Boy / Sunny Mini Central for purposes other than those indicated in this chapter. Other modes of usage can cause the device to be damaged or to become completely inoperable, and can mean that the guarantee no longer applies. If you have questions regarding the proper usage of the Sunny Boy or Sunny Mini Central, contact the Sunny Boy Serviceline.

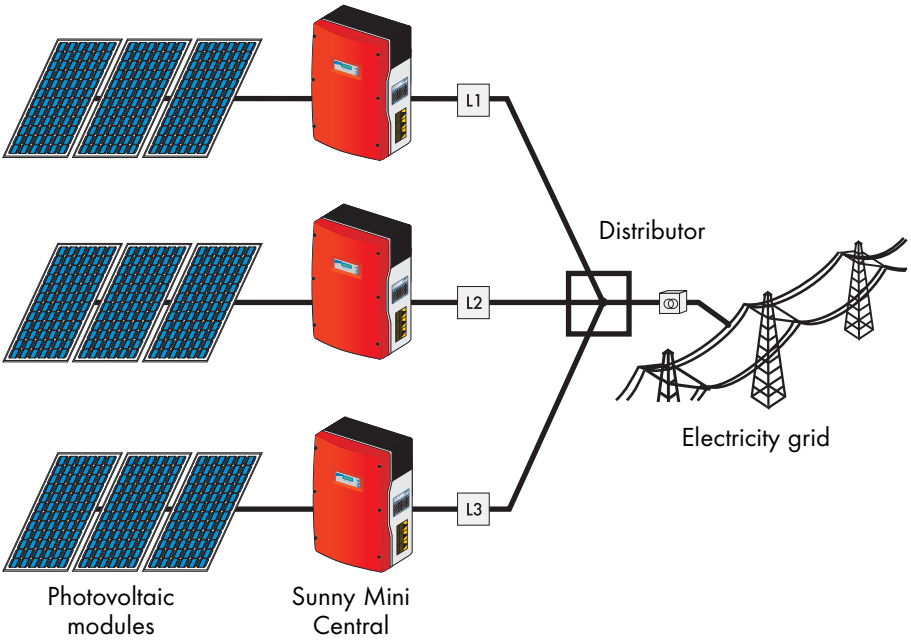
Principle of a grid-connected solar energy system with a string inverter



Principle of a grid-connected solar energy system with a Multi-String inverter



Principle of a grid-connected solar energy system with Sunny Mini Central inverters



3.2 Construction of inverters

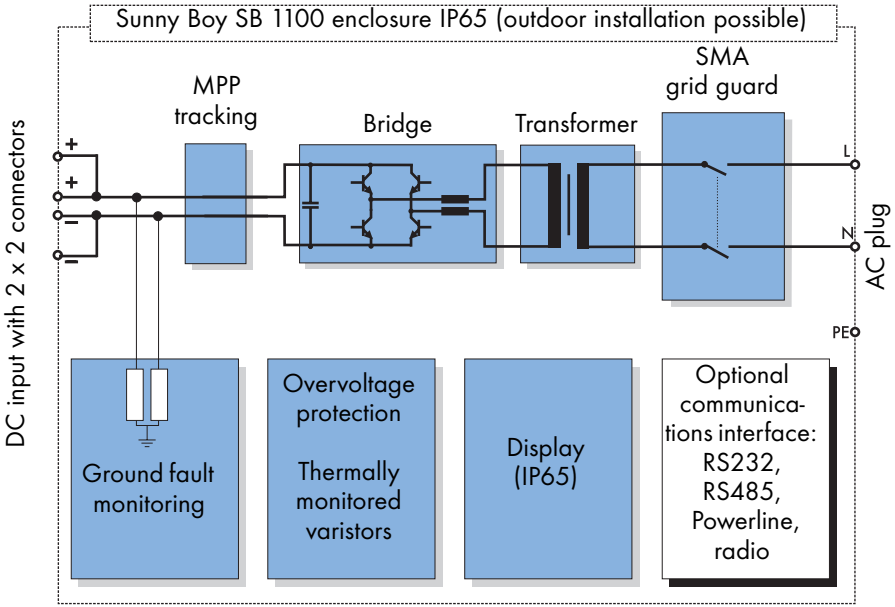
An attractive, functional design is one of the major objectives of the entire SMA product range. The basic configuration of the Sunny Boy / Sunny Mini Central includes the status display consisting of three LEDs, which has proven to be highly reliable, as well as a plain text display. A deliberate decision has been made to avoid the use of controls on the device.

Fine tuning of the device to align it with the solar energy system is not necessary. If this is specifically desired, because of special system conditions, then one of the optional communications interfaces is required. This also allows the current operational data to be recorded on a PC using a special program. This is described in more detail in chapter 7 "System monitoring" (Page 35).

3.2.1 Principle of the string inverter

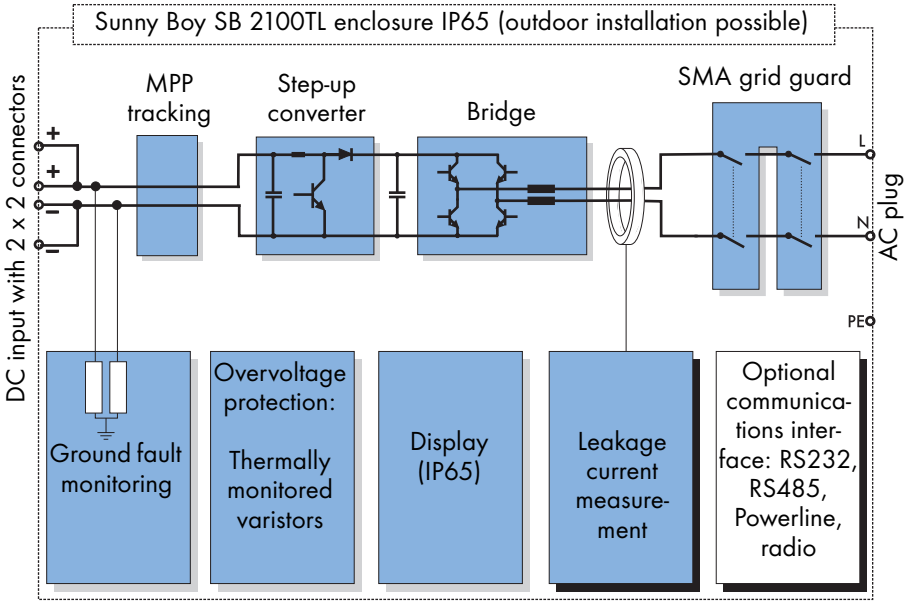
The string inverter is used to connect a small number of series-connected solar modules (strings) to the public grid. A larger solar generator can also be constructed from a number of individual strings, with each having its own string inverter. The energy is then combined on the AC side.

Block circuit diagram of a string inverter with transformer



The Sunny Boy SB 2800i is an indoor inverter. It is protection class IP21 and is only suitable for installation indoors.

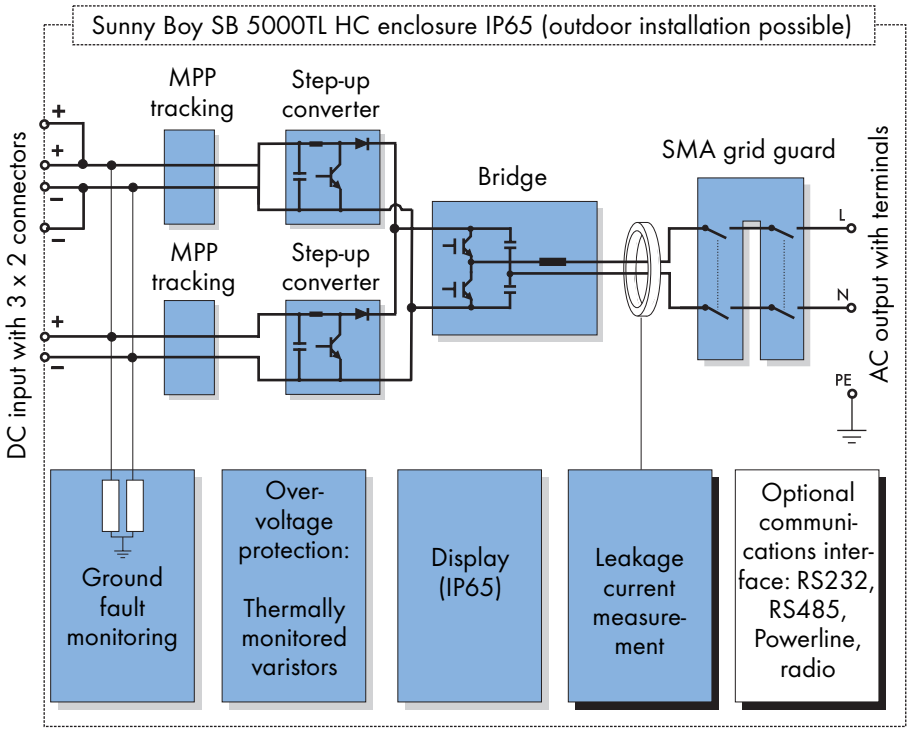
Block circuit diagram of a string inverter without transformer



3.2.2 Principle of the Multi-String inverter

The Multi-String inverter is conceived for use with photovoltaic systems having different strings. As illustrated below, each DC connection of the Sunny Boy SB 5000TL HC Multi-String is allocated to a separate MPP (Maximum Power Point) tracker.

Block circuit diagram of a Multi-String inverter



Depending on the device configuration, up to three independent strings of a PV generator can be connected to a Multi-String inverter. Since each individual input has its own MPP tracker, the strings may differ in respect to the type of modules used and their alignment.

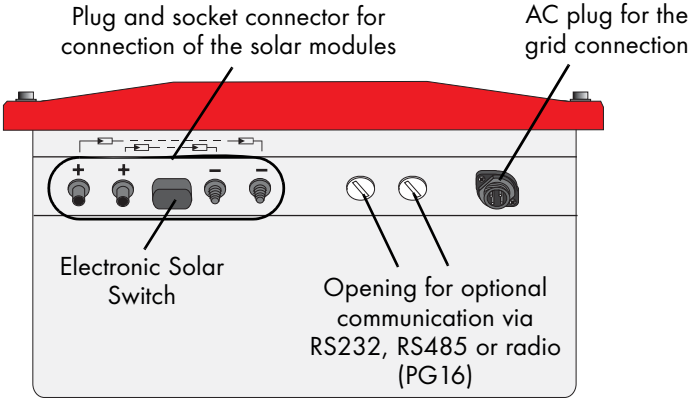
Even the specified current, voltage and power ratings of the individual strings may vary, as long as the limits specified in the installation manual are not exceeded.

The energy from the two or three individual inputs is converted and fed into the grid by a combined inverter assembly.

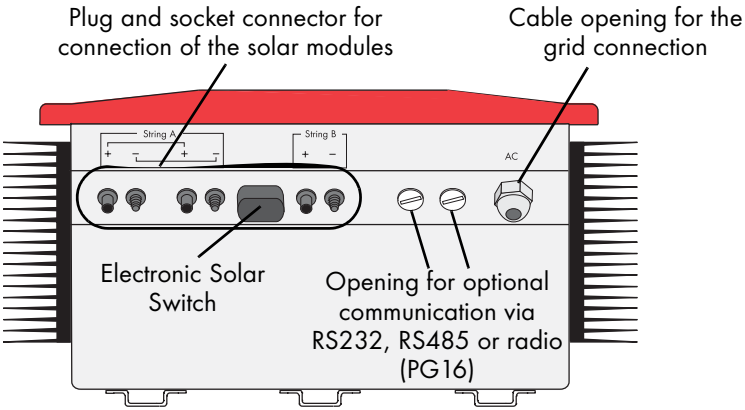
3.2.3 Connection area

All connections are made on the underside of the inverter. The AC connection is made with an AC plug, or else the connection cable is fed through a cable opening in the inverter and connected to the AC terminals inside the device.

Example: Sunny Boy SB 1100

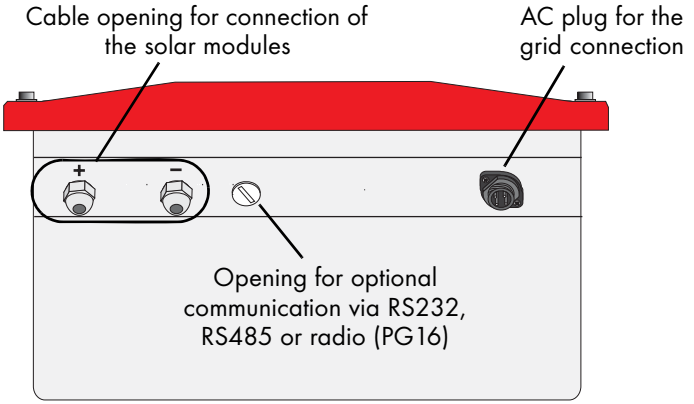


Example: Sunny Boy SB 5000TL HC Multi-String



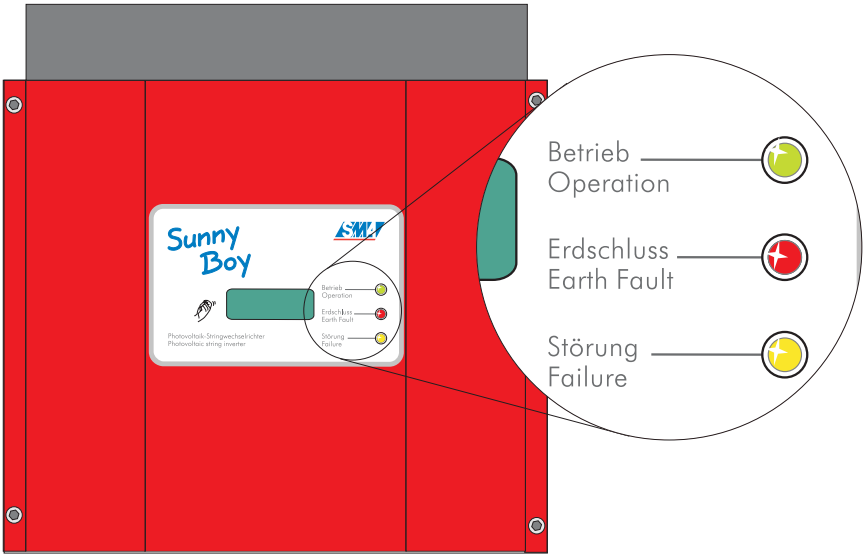
The number and alignment of DC connections varies for the various device types. The devices have one to four plug connector pairs for connecting the solar modules.

Example: Sunny Boy SB 1100LV



4 Operating modes of the inverter

The operating mode is displayed using three light-emitting diodes (LEDs) on the cover of the inverter, and also via the integrated display (see chapter 5 "Information on the display" (Page 31)). To allow the device to signal its operating mode via the 3 integrated LEDs, the inverter must be connected to the DC side of the system. There must be enough solar energy present, so that the inverter has adequate DC voltage.



Especially in the first year of operation, the operator of the system should pay attention to this display, at various times of day and under various conditions of solar irradiation. This allows the detection of hidden faults caused by the orientation or installation of the system, and the assurance that the PV system is operating in accordance with the regulations.

A complete description of the possible LED displays can be found in chapter 4.4 "Description of the operating modes" (Page 20). These can be split into three categories, as described below.

4.1 Normal operation

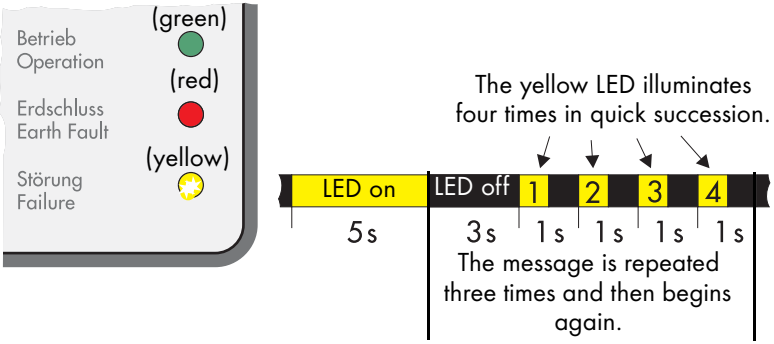
If no LED, or only the green control LED is on, or blinking, the inverter is operating normally. The simultaneous illumination of all three LEDs is also an indication of normal operation ("Initialization"). All other displays are a sign of abnormal operation.

4.2 Critical faulty operation

A comprehensive safety concept has limited the number of critical conditions that can occur to one single situation:

PV generator voltage is too high.

This is indicated by the following blink-code on the yellow LED:



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off and then 4 times briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

Immediately disconnect the PV generator from the inverter. Excessive input voltage can cause serious damage to your device.

4.3 Non-critical faulty operation

All other fault codes indicate some form of faulty operation, which is not usually dangerous to people or equipment, but which should nevertheless be investigated and corrected.

Despite all precautions, it is possible that other faults may occur that cannot be displayed (e.g. failure of the status display). In order to detect such faults, the operator of the system should use the explanations in the following chapter to check the plausibility of the displayed mode (e.g. an illuminated green LED in the middle of the night indicates a fault, as well as no illuminated LED on a sunny day).

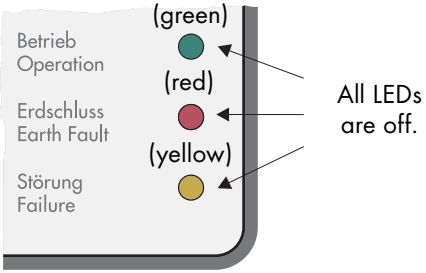
Further detailed diagnoses are possible using the communications options detailed in chapter 7 "System monitoring" (Page 35) .

4.4 Description of the operating modes

4.4.1 Overnight shutdown

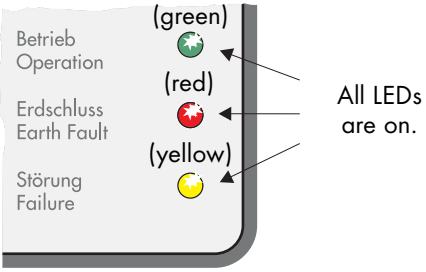
The inverter is in the so-called overnight shutdown mode. This situation occurs when the inverter's input voltage is too low for feeding the grid and for satisfying the on-board power requirements.

If this operating mode occurs during the day on a sunny day, have the PV voltage checked by an installation engineer.



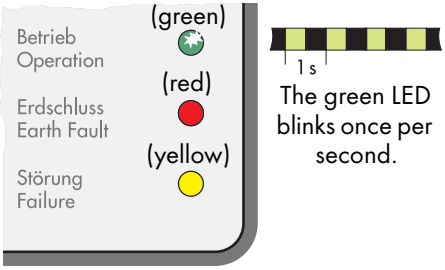
4.4.2 Initialization

The inverter's on-board computer is presently in the initialization phase. The on-board energy supply is present, but there is insufficient energy for feeding the grid and data communication is also not currently possible.



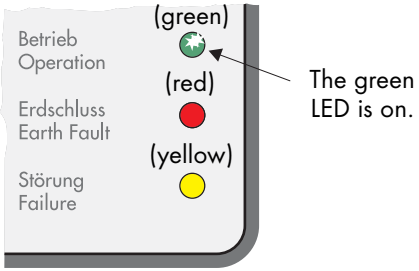
4.4.3 Waiting, grid monitoring

The inverter checks if the initial conditions necessary for feeding the grid are satisfied (e.g. start voltage, start time) and then begins monitoring the grid. The PV voltage must reach the specified minimum value at least once, before the inverter begins feeding into the grid.



4.4.4 Working mode

The inverter has passed the self-tests of the measurement electronics and grid monitoring, and is now in normal grid-feed operation.



MPP mode (standard setting):

Here, the inverter automatically determines the MPP voltage of the solar generator, which is defined in the internal regulation system as the desired PV voltage. In MPP mode, the point of maximum feed-in performance P_{AC} is set by adjustment of the desired PV voltage on the solar generator.

Constant voltage mode:

The operating mode "V-Const" can be manually set by the system operator via the Sunny Boy Control or the Sunny Data PC program. In "V-Const" mode, the Sunny Boy / Sunny Mini Central uses an externally defined desired PV voltage as the basis for internal regulation.

Turbine mode:

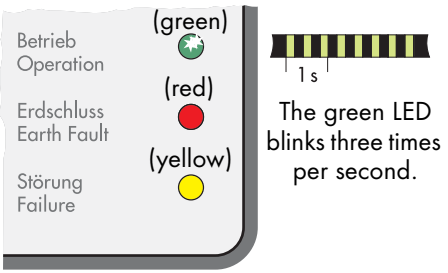
The operating mode "Turbine" can be manually set by the system operator via the Sunny Boy Control or the Sunny Data PC program. In "Turbine" mode, the inverter follows a pre-defined V/I characteristic curve for the conversion of DC current from wind turbines. Details are to be found in the "Windy Boy" documentation.

PV systems must not be operated in "Turbine" mode!

4.4.5 Stop

The inverter is in Stop mode. Among other functions, the measurement electronics are calibrated and then finally, the device switches to "Waiting" mode.

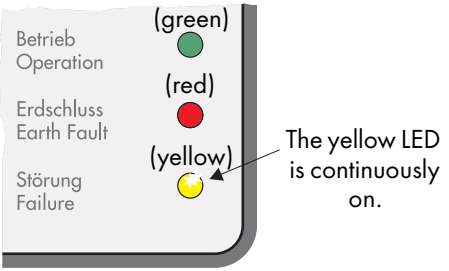
The "Stop" mode can also be manually set by the system operator via the Sunny Boy Control or the Sunny Data PC program. In this case, the inverter remains in "Stop" mode until a new operating mode ("MPP" mode, "V-Const" mode) has been set.



4.4.6 Permanent disable

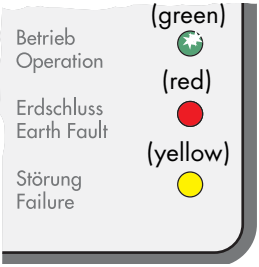
In the event of a recurring fault, the inverter switches from "Working" mode to "Permanent restriction of operation" mode.

A fault may exist that cannot be resolved on-site. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline (chapter 10 "Contact" (Page 67)) to discuss further action to solve the problem.



4.4.7 Derating

The "Derating" operating mode is a normal operating mode which may occur occasionally and can have several causes:



The green LED goes out briefly once per second.

Temperature derating

The temperature monitoring of the inverter has reduced the output performance to prevent the device from overheating. The inverter enters the "Temperature derating" mode. If the Sunny Boy / Sunny Mini Central switches to this operating mode often, you should check the heat dissipation and install the inverter in a more suitable position with better ventilation. If the unit is a Sunny Mini Central, Sunny Boy SB 3800, SB 3300 or SB 2800i, check whether the fans are dirty.

Fan cleaning is described in the respective installation manual.

Current derating

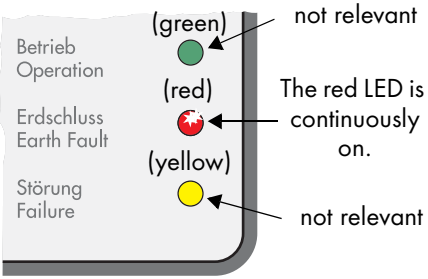
Due to the module type or the generator output and wiring, the PV-side input current exceeds the maximum possible input current. The inverter switches to the "Current derating" mode in order to protect itself against overload. Check the system design.

Output derating

This operating mode only occurs in systems which are operated using the Sunny Mini Central with the integrated SMA Power Balancer in the "PowerGuard" setting. If outputs of over 5 kVA are to be fed in one phase, it is usually necessary to construct a 3-phase system from 3 identical inverters. This is imperative to avoid an unbalanced load between phases L1 - L3. If one of the three inverters ceases to feed into the grid, the other two inverters reduce their maximum output to 5 kVA. Check the devices' operational conditions, and remove the fault. More information on the SMA Power Balancer can be found in the Sunny Mini Central's installation manual.

4.4.8 Insulation fault or defective varistor

The red LED on the Sunny Boy / Sunny Mini Central is continuously on. With this blink code, it is not relevant if the green or yellow LEDs shine or blink. A grounding fault exists or one of the thermally monitored varistors on the DC input is defective as a result of overvoltage or ageing. In this event, only devices with transformers (without "TL" in the device name) continue to feed electricity.

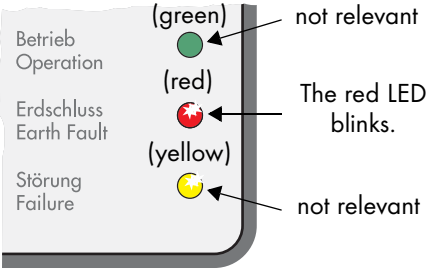


Consult trained electrical personnel to correct the fault. Fault removal instructions can be found in the inverter's installation manual.

4.4.9 Defective DC input

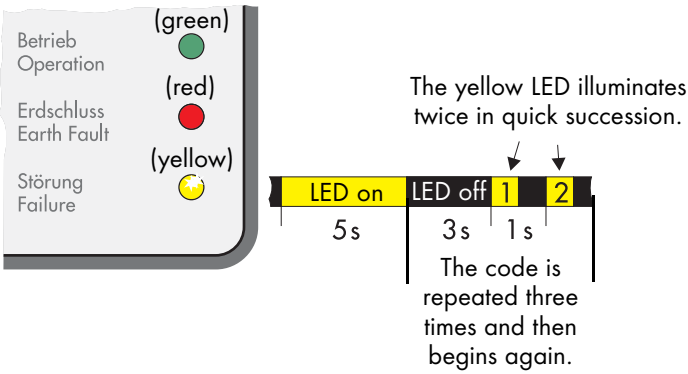
Sunny Boy Multi-String

The red LED blinks. With this blink code, it is not relevant if the green or yellow LEDs are on of off. At least one of the DC inputs is defective.



A fault has occurred which can no longer be resolved on-site. Consult SMA (see chapter 10 "Contact" (Page 67)) to discuss further action.

4.4.10 Grid fault



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then twice briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

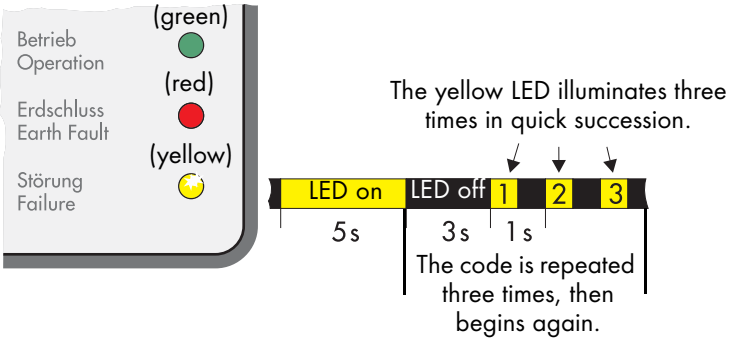
With this message, the inverter indicates a grid fault, which can have the following causes:

- Low grid voltage (U_{AC} < "Uac-Min")
- High grid voltage (U_{AC} > "Uac-Max")
- Low grid frequency (f_{AC} < "Fac-Min")
- High grid frequency (f_{AC} > "Fac-Max")
- A change in grid frequency ("dFac")
- Faulty grid connection (e.g. N and L swapped)
- In systems which consist of three or more Sunny Mini Centrals, the SMA Power Balancer has detected a fault.

Check if a general grid dropout has occurred (check the operation of other electrical consumer devices), check that the fuses in the feed-in connections of the inverter are undamaged and check if the automatic cutout is switched on.

If none of these faults can be found, have the grid connection of the Sunny Boy / Sunny Mini Central checked by qualified electrical personnel.

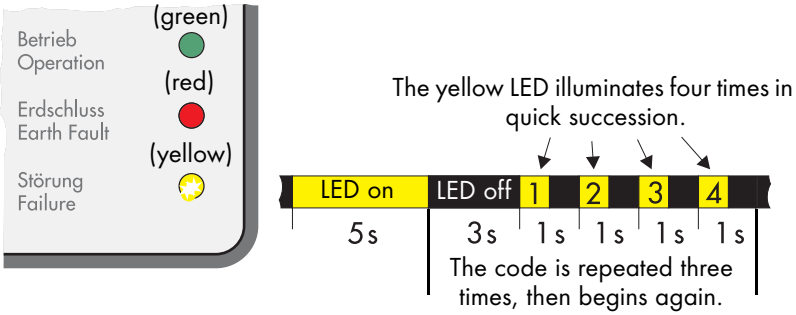
4.4.11 Grid impedance



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then 3 times briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

The inverter has detected a fault relating to an unacceptable impedance in the grid. If the inverter frequently displays this fault during grid monitoring, the cause can be a grid impedance that is too high. An electrician can usually assist with this problem by increasing the cross section of the grid connection cable. Tightening the terminal clamps on the connection cable can also help. Other measures can be taken to correct this problem, but they require the aproval of the electricity supplier.

4.4.12 Input voltage (PV generator) too high

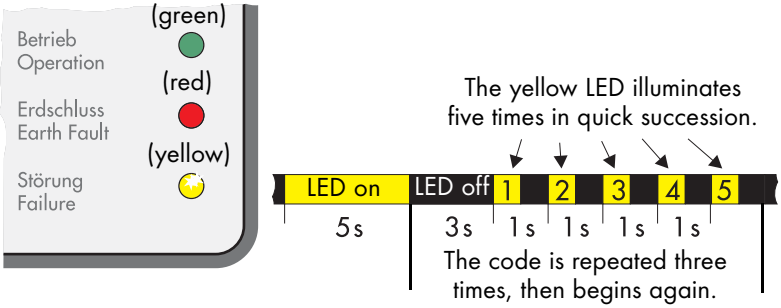


The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then 4 times briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

The voltage of the PV generator exceeds the inverter's permissible input voltage!

Immediately disconnect the PV generator from the Sunny Boy / Sunny Mini Central. Excessive input voltage can cause serious damage to your device.

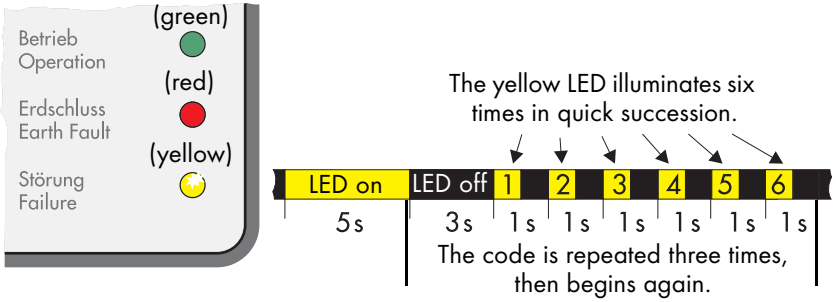
4.4.13 Device fault



The yellow fault LED illuminates for 5 seconds when the fault occurs, and then begins displaying the blink code of: 3 seconds off, then 5 times briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

If the device fault leads to a major reduction in normal operation, the inverter and the entire system installation should be checked by an electrician. You must take particular care that devices without transformers (with "TL" in the device name) are correctly grounded!

4.4.14 Leakage current too high



*The "Leakage current too high" fault can only occur in transformerless inverters. Inverters without transformers can be identified by their full name; the TL in the name stands for transformerless: e.g. Sunny Boy SB 5000**TL** HC Multi-String.*

The yellow fault LED illuminates for 5 seconds when the fault occurs, then begins displaying the blink code of: 3 seconds off, then 6 times briefly on. This code is displayed three times in succession. If the fault is still present, the fault display starts again from the beginning.

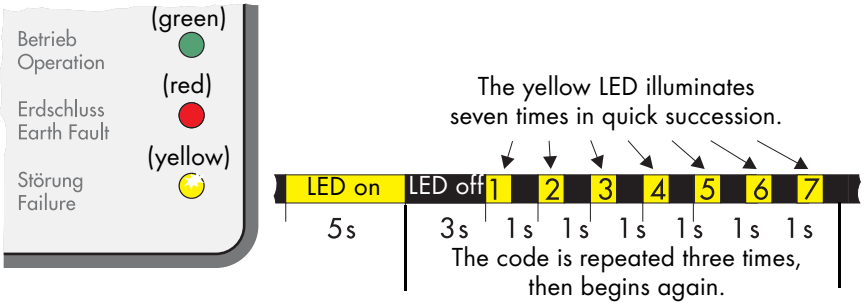
The leakage current of the inverter and the PV generator is too high. The Sunny Boy / Sunny Mini Central immediately stops feeding the grid as soon as the limit has been reached, then automatically resumes normal operation when the fault is no longer present.

The leakage current is dependent on the capacity of the PV generator relative to ground and depends equally on the type of modules and manner of installation as well as the weather conditions. A variation of this value over time is therefore normal.

If however, the inverter frequently displays this fault, notify the installation engineer who installed your PV system and clarify the reasons for the high level of leakage current.

A PE connection to the inverter that is not connected can also cause this fault message. Have your installation engineer check this.

4.4.15 Changes in differential current



*The "Changes in differential current" fault can only occur in transformerless inverters. Inverters without transformers can be identified by their full name; the TL in the name stands for transformerless: e.g. Sunny Boy SB 5000**TL** HC Multi-String.*

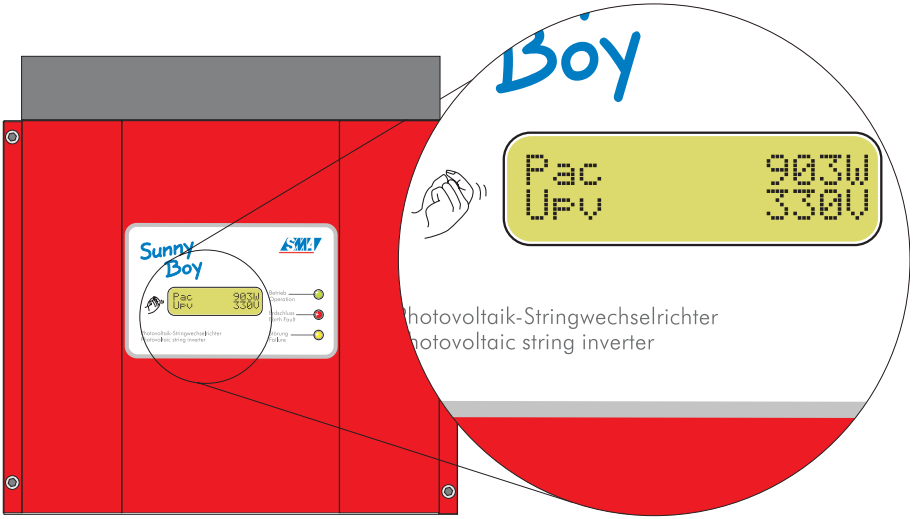
The yellow fault LED illuminates for 5 seconds when the fault occurs, then begins displaying the blink code of: 3 seconds off, then 7 times briefly on. This code is displayed three times in succession.

If the fault is still present, the fault display starts again from the beginning.

The Sunny Boy / Sunny Mini Central has detected a change in differential current and has immediately disconnected itself from the grid feed. The inverter has an integrated universal differential current sensor that monitors the leakage current relative to earth between the inverter's grid connection and the solar generator. This additional personal protection reacts to a jump in the differential current of I_{DN} > 30 mA and disconnects the Sunny Boy / Sunny Mini Central from the grid within 0.2 seconds.

5 Information on the display

Sunny Boys and Sunny Mini Centrals have a factory-installed LCD display on the cover.



Detailed explanations of the individual operational parameters, error messages and fault messages can be found in chapter 8 "Measurement channels and messages" (Page 43).

5.1 Switching on the display illumination

The background illumination is switched on by tapping on the lid of the enclosure. Tapping again switches the display to the next message.

After 2 minutes, the illumination switches off automatically.

5.2 Display messages in the startup phase

After startup of the inverter, the display shows the device type.

```
SunnyBoy xxx
WRxx
```

After 6 seconds, the firmware version of the operation control unit (BFR) and the current control unit (SRR) are displayed.

```
BFR Version x.xx
SRR Version x.xx
```

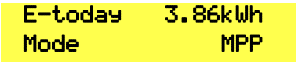
Inverters which are equipped with the SMA Power Balancer subsequently indicate the operating mode of the SMA Power Balancer.

```
Power Balancer
PhaseGuard
```

5.3 Display messages during operation

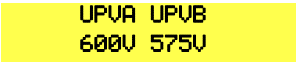
The display shows the most important operational information of the inverter in a continuous cycle. The following five diagrams serve to clarify the messages. Each message is displayed for 5 seconds. Then the cycle begins again.

The energy generated today and the current operating mode are displayed first.

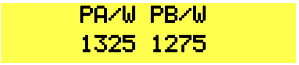


Finally, the present feed-in performance and voltage of the solar generator are displayed.

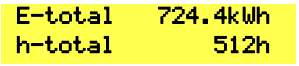
With Multi-String inverters, the input voltage of each of the two or three input strings is displayed as illustrated to the right.



With Multi-String inverters, this is then followed by the input power of the two or three input strings.



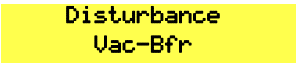
This is then followed by the total energy produced so far and the operational hours of the device.



5.3.1 Fault displays

If an operational fault develops, the display immediately switches to "Fault" and the background illumination is switched on.

The cause of the fault is displayed for 5 seconds in the second line of the display.



If a measured value is responsible for the fault condition, then the value measured at the time of the fault is displayed. If another measurement is possible, the present value is displayed in the second line.

After another 5 seconds, normal operational information is again displayed. If the fault is still present, the fault display starts again from the beginning. An overview of the status messages and error messages can be found in chapter 8 "Measurement channels and messages" (Page 43) of this document.

"Error ROM" indicates that the inverter has recognized a fault in the EEPROM firmware. Contact SMA to have the fault corrected.

5.3.2 DC overvoltage

If an excessive DC input voltage is present at the Sunny Boy / Sunny Mini Central, then this is indicated by rapid blinking of the background illumination and a corresponding message.

Immediately disconnect the PV generator from the Sunny Boy / Sunny Mini Central. Excessive input voltage can cause serious damage to your device.

Before returning the device into operation, the open circuit voltage of the PV generator must be checked by an electrician!

6 Maintenance and care

To enable the Sunny Boy / Sunny Mini Central to be used outdoors in places that are difficult to access, the inverters have been constructed for low maintenance. To guarantee safe operation, it is usually adequate to check the device visually for damage approximately every two months. It should also be checked as to whether the green LED is illuminated.

The Sunny Boy SB 2800i is not designed for installation outdoors. It is only suitable for indoor installation.

However, in the interests of maximum yield, the operator should check weekly if possible, under various conditions of solar irradiation, if the inverter's displays indicate plausible normal operation (see chapter 4.4 "Description of the operating modes" (Page 20)). Naturally, this information can also be obtained by using one of the communications options.

Cleaning the inverter is only necessary if the heat dissipation is limited by dirty handle covers (fan gills), dirty fans, dirty heatsinks or a dirty space between the Sunny Boy / Sunny Mini Central and the wall. The dirt should be carefully removed with an appropriate soft brush or paintbrush. A detailed description of how to clean the fans (e.g. of the Sunny Boy SB 3800 or the Sunny Mini Central SMC 6000A) can be found in the installation manual of the respective device.

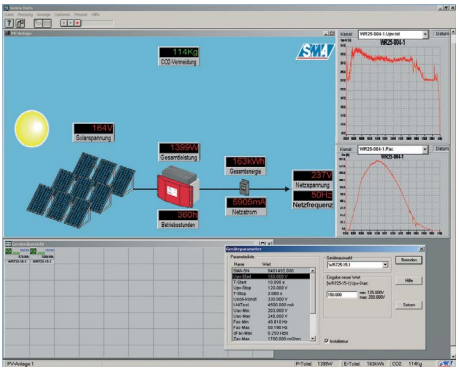
If the display or the status LEDs are so dirty that they can no longer be seen, then they can be cleaned with a damp cloth. Solvents, abrasives or corrosive liquids must not be used!

7 System monitoring

A PV system with inverters from the Sunny Family can be monitored in different ways. SMA offers a range of products for this purpose, allowing you to install a tailor-made monitoring system for your PV system. If you require detailed information, request the Sunny Family catalog or visit www.SMA.de. In the following sections the currently available communications options are schematically described.

7.1 Sunny Data

Sunny Data is a PC program for direct monitoring of your system. The connection of Sunny Boys or Sunny Mini Centrals to the PC is described in the following sections.

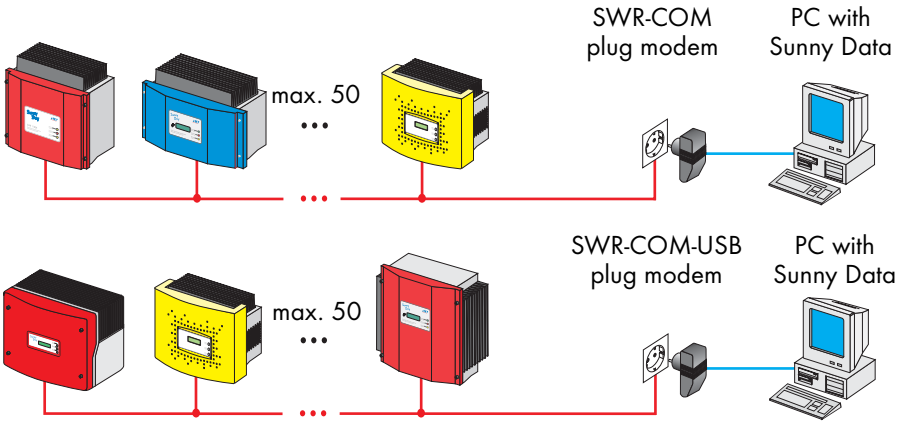


7.1.1 Sunny Data via Powerline

Communication via the grid power line

(up to 50 SMA inverters)

Requirements: the inverters must be equipped with a Powerline Piggy-Back and the PC must have an SWR-COM or SWR-COM-USB plug modem. The connection to a PC via the SWR-COM or SWR-COM-USB is described in the documentation for the SWR-COM / SWR-COM-USB.



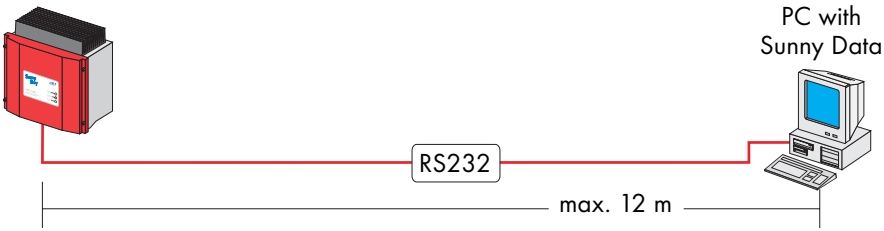
Sunny Mini Centrals cannot communicate via Powerline.

7.1.2 Sunny Data over RS232

Communication via a cable

(one SMA inverter)

Requirements: the inverter must be equipped with an RS232 Piggy-Back, the connection to the PC usually occurs directly via the COM1 or COM2 port of the PC. The installation of the RS232 cable is described in the inverter's installation manual.

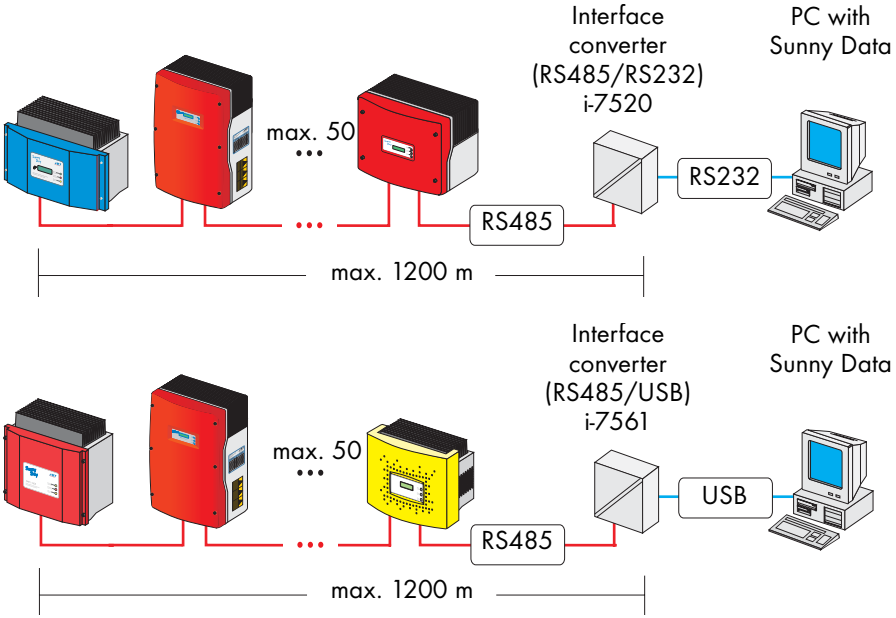


7.1.3 Sunny Data over RS485

Communication via a cable

(up to 50 SMA inverters)

Requirements: all inverters must be equipped with an RS485 Piggy-Back, the connection with the PC usually occurs via an RS485/RS232 interface converter connected to the COM1 or COM2 port or via an RS485/USB interface converter connected to the USB port. The installation of the RS485 cable is described in the Sunny Data installation manual.

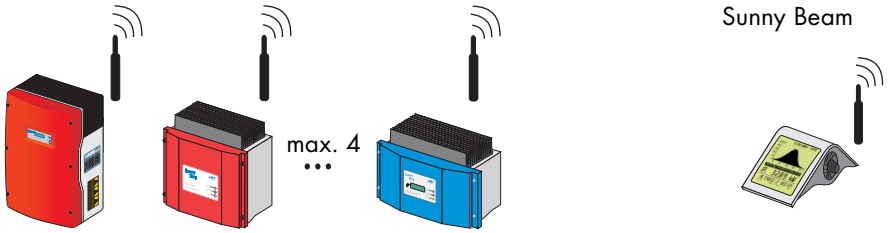


7.2 Sunny Beam

Simple wireless system monitoring for up to 4 SMA inverters.

Requirements: the inverters must be equipped with a radio Piggy-Back and a Sunny Beam must be present at an appropriate distance. The maximum distance of the Sunny Beam from the system is 30 m within a building and 100m outdoors. The installation of the radio Piggy-Back is described in the Sunny Beam user manual.

With the Sunny Beam, the inverter parameters cannot be altered.

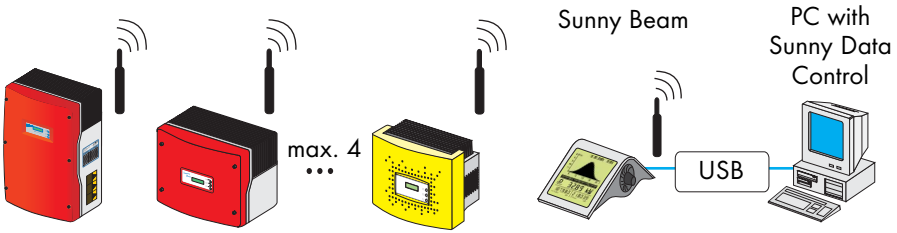


7.2.1 Sunny Data Control over Sunny Beam

Communication with a PC over Sunny Beam

(up to 4 Sunny Boys or Sunny Mini Centrals)

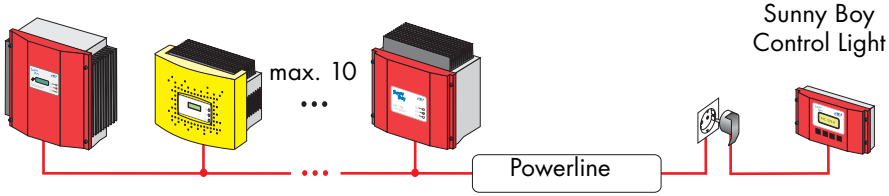
Requirements: all 4 inverters must be equipped with a radio Piggy-Back and be accessible to Sunny Beam for system monitoring. The maximum distance of the Sunny Beam from the system is 30 m within a building and 100 m outdoors. The Sunny Beam is connected to the PC via a USB cable. The installation of the radio Piggy-Backs and the connection to the PC is described in the Sunny Beam user manual.



7.3 Sunny Boy Control Light

The simple data logger for PV systems with up to 10 inverters. The connection between the Sunny Boy Control Light and the inverters occurs via Powerline.

Requirements: the inverters must be equipped with a Powerline Piggy-Back. The installation is described in detail in the Sunny Boy Control Light documentation.



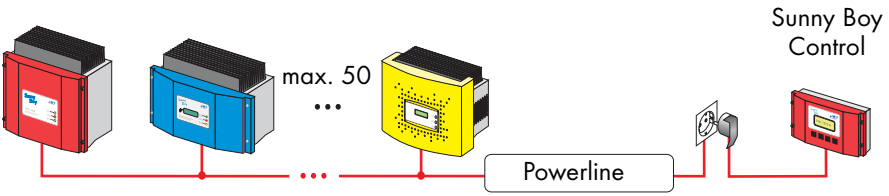
Sunny Mini Centrals cannot communicate via Powerline.

7.4 Sunny Boy Control

The data logger for PV systems with up to 50 SMA inverters. The connection between Sunny Boy Control and Sunny Boys / Sunny Mini Centrals can be made in the following ways:

Powerline - communication via the grid power line

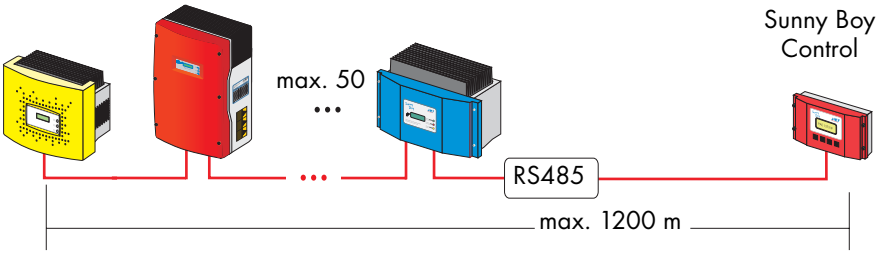
Requirements: all inverters must be equipped with a Powerline Piggy-Back. The installation is described in detail in the Sunny Boy Control documentation.



Sunny Mini Centrals cannot communicate via Powerline.

RS485 communication via a cable

Requirements: all inverters must be equipped with an RS485 Piggy-Back, the Sunny Boy Control must be equipped with an RS485 Piggy-Back at the "COM1 - Sunny Boy" interface. The installation is described in detail in the Sunny Boy Control documentation.



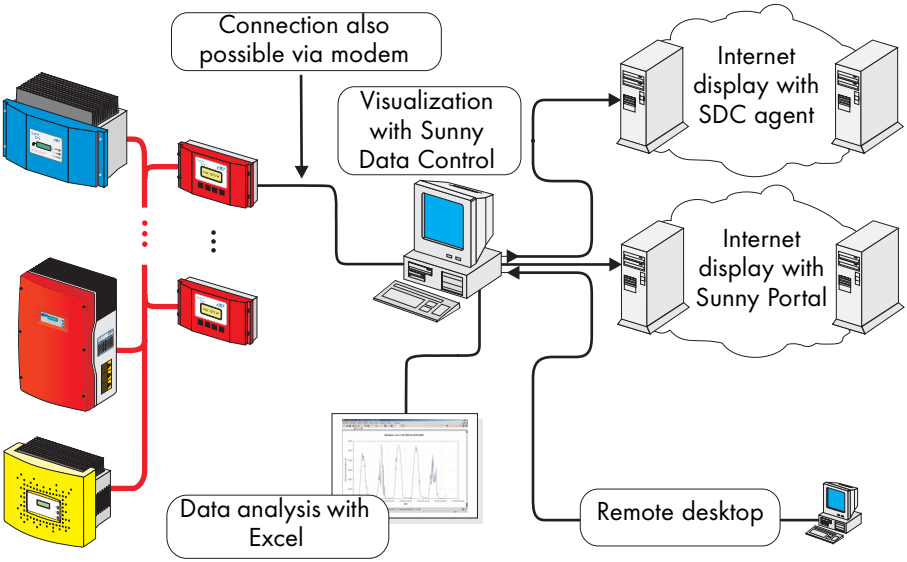
7.5 Sunny Boy Control Plus

The data logger for PV systems with up to 50 inverters, an additional interface for connection to a PC or large display and additional connection possibilities for digital and analog inputs and outputs. Requirements: see chapter 7.4 "Sunny Boy Control" (Page 39).

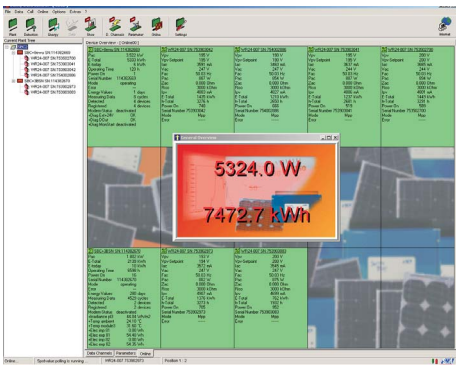
7.6 Sunny Data Control

This is a PC program for system monitoring and visualization on a PC for systems with a Sunny Boy Control.

Requirements: PV system with Sunny Boy Control, Sunny Boy Control Plus, Sunny Boy Control Light or Sunny Beam with a connection to a PC.

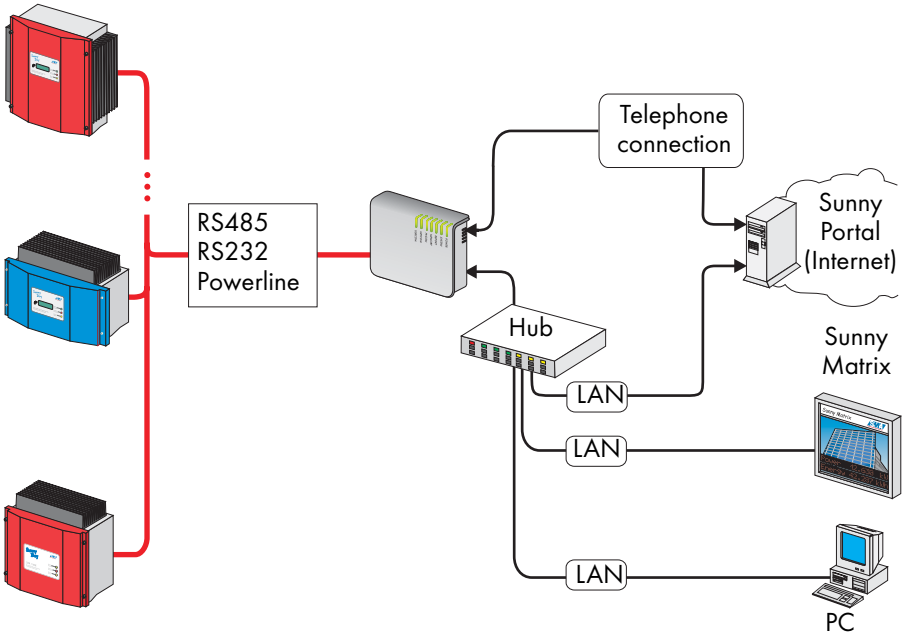


The connection between the PC and the Sunny Boy Control can occur via modem if required. Large systems with more than 50 inverters can be monitored by coupling several Sunny Boy Controls together.



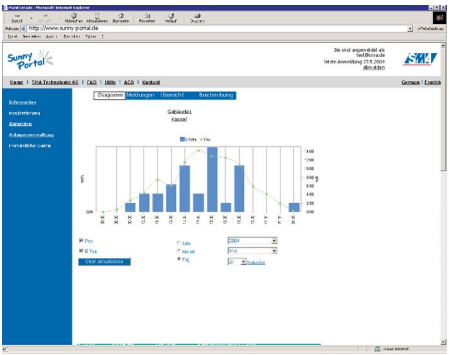
7.7 Sunny WebBox

The Sunny WebBox is a versatile inexpensive platform for system visualization directly on a PC or via the Internet using the Sunny Portal.



7.8 Sunny Portal

The Sunny Portal is a high performance interface from SMA for the monitoring and presentation of your system in the Internet. Details can be obtained from the Sunny Family catalog or directly at www.SUNNY-PORTAL.com.



8 Measurement channels and messages

If your inverter is equipped with a communications component, then numerous measurement channels and messages can be transmitted.

The following abbreviations apply:

BFR: Operation control unit

SRR: Current control unit

8.1 Measurment channels

Measurement channel	Description
Balancer	Indicates the currently active operating mode of the Sunny Mini Central, which is set via the operating parameter "PowerBalancer".
dI	Leakage current of the PV system (inverter and PV generator)
E-Total	Total amount of feed-in energy
E-Total DC-A	Total amount of feed-in energy from string A (Multi-String inverters only)
E-Total DC-B	Total amount of feed-in energy from string B (Multi-String inverters only)
E-Total DC-C	Total amount of feed-in energy from string C (Multi-String inverters only)
Event-Cnt	The number of events recorded since the last reset
Fac	Grid frequency
Fehler	Identification of the present fault / error.
Error	
Fehler-Cnt	The number of faults recorded since the last reset
Error-Cnt	
h-On	Total hours of operation
h-Total	Total hours of grid feed-in operation
h-Total DC-A	Total feed-in operational hours of string A (Multi-String inverters only)
h-Total DC-B	Total feed-in operational hours of string B (Multi-String inverters only)
h-Total DC-C	Total feed-in operational hours of string C (Multi-String inverters only)

Measurement channel	Description
Iac-Ist	Grid current
Ipv	DC current
Netz-Ein	Total number of grid switch-ons
Power on	
Pac	Instantaneous AC power
Phase	The phase to which the inverter is connected. The phase (L1 - L3) is set via the operating parameter "Netzanschluss".
PPV DC-A	PV generator output string A (Multi-String inverters only)
PPV DC-B	PV generator output string B (Multi-String inverters only)
PPV DC-C	PV generator output string C (Multi-String inverters only)
Riso	Insulation resistance of the PV system to the grid connection
Erdschluss	
Earthfault	
Seriennummer	Inverter's serial number
Serial number	
Status	Display of the current operating mode
State	
Uac	Grid voltage
Vac	
Ufan, U-Fan	Fan supply voltage (only in inverters with an active cooling system)
Upv-Ist	PV input voltage
Vpv	
Upv-Ist DC-A	PV input voltage string A (Multi-String inverters only)
Vpv DC-A	
Upv-Ist DC-B	PV input voltage string B (Multi-String inverters only)
Vpv DC-B	
Upv-Ist DC-C	PV input voltage string C (Multi-String inverters only)
Vpv DC-C	

Measurement channel	Description
Upv-Soll	PV voltage
Vpv-Setpoint	
Upv-Soll DC-A	PV voltage string A (Multi-String inverters only)
Upv-Soll DC-B	PV voltage string B (Multi-String inverters only)
Upv-Soll DC-C	PV voltage string C (Multi-String inverters only)
Zac	Grid impedance

8.2 Status messages

Sunny Boys and Sunny Mini Centrals produce a range of status messages, depending on the mode in which they are currently operating. The status messages can vary, depending on the type of communication which you use.

Message	Description
Balanced	The Sunny Mini Central has disconnected itself from the grid, or is limiting its output to 5 kVA over a 10 minute average. The Sunny Mini Central is part of a three-phase system with two further Sunny Mini Centrals and equipped with the SMA Power Balancer for prevention of unbalanced loads. The "Balanced" message is displayed as a result of the following: Case 1: The operating parameter "PowerBalancer" is set to "PhaseGuard". One of the three Sunny Mini Centrals in this system has indicated a grid fault, and disconnected itself from the grid. Thus, this Sunny Mini Central also disconnects itself from the grid in order to prevent an unbalanced load. Case 2: The operating parameter "PowerBalancer" is set to "PowerGuard". One of the three Sunny Mini Centrals in this system has detected a device fault or grid fault, and disconnected itself from the grid. The two remaining Sunny Mini Centrals reduce their output to 5 kVA over a 10 minute average, in order to prevent an unbalanced load. Case 3: The operating parameter "PowerBalancer" is set to "FaultGuard". One of the three Sunny Mini Centrals in this system has indicated a device fault or grid fault, and disconnected itself from the grid. In the event of a grid fault, this Sunny Mini Central also immediately disconnects itself from the grid in order to prevent an unbalanced load. In the event of a device fault, the fault message is sent to the other two devices with a delay of 5 minutes. After the 5 minutes have passed, the other two devices disconnect themselves from the grid. With the aid of chapter 8.4 "Fault messages" (Page 55), check which fault occurred in the first inverter, and proceed as recommended in that chapter.

Message	Description
Derating	Overtemperature in the inverter. The Sunny Boy / Sunny Mini Central reduces its performance to prevent the device from overheating. To avoid unnecessary yield losses, the configuration and string size should be checked. Check whether the Sunny Boy or Sunny Mini Central can be located in a better position with better ventilation, thus enabling sufficient heat dissipation. With fan devices, check the fans for dirt. A detailed description of how to clean the fans (e.g. of the Sunny Boy SB 3800 or the Sunny Mini Central SMC 6000A) can be found in the installation manual of the respective device.
Derating Idc, derat. Idc, Der. Idc	An overcurrent condition is present on the DC side of the inverter. The inverter reduces the output power. This status does not damage your system but energy is lost. If this message is regularly displayed, ask your installation engineer to check your system.
Derating WR, Der. T. WR	Overtemperature in the inverter ("WR") or in the performance electronics. The Sunny Boy / Sunny Mini Central reduces its output to prevent the device from overheating. To avoid unnecessary yield losses, the configuration and string size should be checked. Check if the inverter can be installed in a better position with better ventilation. With fan devices, check the fans for dirt. A detailed description of how to clean the fans can be found in the installation manual of the respective device.
Derating DC, Der. T. DC	
Fehler, Error	A fault has been detected (see chapter 8.4 "Fault messages" (Page 55)).
I-Konst	Constant current operation (the input current of the PV system is set to a specified desired value, the inverter is not operating in MPP mode). In some cases, this can be set as the operating mode.
I-Const	
MPP	The Sunny Boy / Sunny Mini Central is operating in MPP mode. It extracts the highest possible output from the PV generator. MPP is the standard display when operating with normal sunshine.
Mpp Peak	The inverter is operating in MPP mode above its rated capacity.
Netzueb.	Testing the grid status, relay test etc. This message appears during the startup phase, before the Sunny Boy or Sunny Mini Central is connected to the grid. The message usually appears in the morning and evening when there is little solar irradiation. Grid monitoring is also performed after the occurrence of a fault.
grid. mon	
grid monitoring	

Message	Description
Off Grid	The inverter is in "Island" mode. This mode is specially conceived for operation in a stand-alone grid with a Sunny Island as network controller. More information about this topic can be obtained from the Sunny Island operating manual under the category "Droop Mode".
Offset	Offset compensation of the measurement electronics.
Riso	Measurement of the insulation resistance of the PV system.
Störung	Fault (see "Fault messages" table) This fault occurs for reasons of safety and prevents the Sunny Boy / Sunny Mini Central from connecting to the grid.
Stoer.	
disturb.	
disturbance	
Stop	Interruption of operation after a fault. This status can also be set manually.
Turbine Mode	The inverter is in "Turbine" mode. This mode is specially conceived for use with wind energy systems. Further information on this topic can be found in the Windy Boy instruction manuals
U-Konst, V-Const	Constant voltage operation (the input voltage of the PV system is set to a specified desired value, the inverter is not operating in MPP mode). In some cases, this can be set as the operating mode.
Warten, waiting	The switch-on conditions are not (yet) satisfied.

8.3 Operating parameters

Unauthorized changes to the operating parameters may result in:

- **injury or accidents as a result of changing the internal safety routines in the Sunny Boy / Sunny Mini Central,**
- **voiding the operating approval certificate of the Sunny Boy / Sunny Mini Central,**
- **voiding the guarantee of the Sunny Boy / Sunny Mini Central.**

Never change the parameters of your Sunny Boy / Sunny Mini Central without express authorization and instructions.

Name	Description
ACVtgRPro	Surge voltage protection (only relevant for Germany). Sunny Boys and Sunny Mini Centrals can feed into the public grid with up to 260 V AC. However, DIN VDE 0126-1-1 stipulates that the average AC voltage over 10 minutes must not exceed 253 V. If the average over 10 minutes exceeds the threshold value of 253 V, the inverter disconnects itself from the grid. Once the average over 10 minutes returns to a value of less than 253 V, the inverter returns to "Working" mode. If surge voltage protection is not required in the relevant grid area (outside Germany), it can be deactivated by means of presetting the LDVtgC parameter. In this event, only the fast cut-off via the Uac-Max parameter intervenes.
AntiIsland-Ampl	Amplification of the AntiIsland process (alternative AntiIslanding process, which is deactivated for Germany).
AntiIsland-Freq	Repetition rate of the AntiIsland process (alternative AntiIslanding process, which is deactivated for Germany).
Betriebsart Operating Mode	Operating mode of the Sunny Boy / Sunny Mini Central: MPP: Maximum Power Point UKonst (V-Const): constant voltage mode (desired voltage is defined in "Usoll-Konst" ("Vconst-Setpoint")). IKonst (I-Const): operating mode for test purposes. Stop: disconnection from grid, no operation. Turbine Mode: operating mode for wind energy systems. Off Grid: operating mode for inverters in a stand-alone grid.

Name	Description
Control	Current regulation switching. If the operating parameter "Control" is set to "Auto", the inverter automatically chooses the optimal type of current regulation. If the operating parameter "Control" is set to "Grid", the inverter regulates on the grid side. If set to "Bridge", the inverter regulates on the bridge side. This setting can be a corrective measure in the event of difficult grid characteristics. Discuss the alteration of this parameter with the SMA Serviceline.
Default	Used for setting the country specific-information. GER/ENS: country-specific parameter settings for Germany in accordance with DIN VDE 0126 (4.99). GER/VDE0126-1-1: country-specific parameter settings for Germany in accordance with DIN VDE 0126-1-1. SP/RD1663: country-specific parameter settings for Spain. AUS/AS4777: country-specific parameter settings for Australia. IT/DK5950: country-specific parameter settings for Italy. GB/G83: country-specific parameter settings for Great Britain. Other: here, parameter settings can be defined for countries for which no predefined setting exists. Trimmed: if country-specific parameters have been changed, "trimmed" is shown in the display. Off_Grid: setting for inverters which are operated in a stand-alone grid. More detailed information can be found in the Sunny Island manual.
dFac-Max	Maximum "grid frequency change" before the grid monitoring system disconnects the device from the grid.
dZac-Max	Maximum "grid impedance change" before the grid monitoring system disconnects the device from the grid.
E_Total	Total energy yield for the inverter. This change may be necessary when you exchange your Sunny Boy and want to use the data from the old device.
Fac-delta-	Maximum frequency, above (Fac-delta+) and below (Fac-delta-) the grid frequency of 50 or 60 Hz, before the grid monitoring system disconnects the device from the grid.
Fac-delta+	
Fac-LimitDelta	For setting the frequency-dependent output derating in the operating mode "Off Grid". Further information on this topic can be found in the Sunny Island instruction manual.
Fac-StartDelta	

Name	Description
Fan-Test	If you set the "Fan-Test" parameter to "1" you can check whether the fan is functioning (only for fan devices).
h_Total	Total hours of operation for the inverter. This change may be necessary when you exchange your Sunny Boy and want to use the data from the old device.
LDVtgC	Compensation for the voltage drop in the cabling. With this parameter, the voltage drop between the inverter and the grid connection point is taken into account. The average voltage over 10 minutes at the inverter connection must not exceed the sum of ACVtgRPro plus LDVtgC. The parameter LDVtgC is preset to 0 V for Germany. In grid areas in which the additional surge voltage protection (see parameter ACVtgRPro) is not required, the parameter LDVtgC is preset to 50 V. Thus, the surge voltage protection is deactivated for these grid areas (253 V + 50 V = 303 V) and only the fast cut-off via the Uac-Max parameter intervenes.
I-Ni-Test	Setting the impulse for impedance monitoring (0 = off). This parameter only functions when the inverter is deactivated (disconnection on the AC side) or in "Stop" mode.
testcurrent Zac	
Inst.-Code	Parameters for self contained power system recognition can only be changed after entering the "SMA grid guard" password.
KI-Wind-Reg	Control factors in Turbine Mode. Further information on this topic can be found in the Windy Boy instruction manuals
KP-Wind-Reg	
Netzanschluss	With this operating parameter, it is possible to store information in the inverter, regarding which phase the inverter is connected to. This means that in the system overview it is easy to manage which inverter is installed at which phase.
NiTest	Activation and deactivation of the self contained power system recognition by impedance monitoring (0 = off / 1 = on). This parameter only functions when the inverter is deactivated (disconnection on the AC side) or in "Stop" mode.

Name	Description
PowerBalancer	Operating mode of the SMA Power Balancer for prevention of unbalanced loads in 3-phase systems with Sunny Mini Centrals. The SMA Power Balancer has four operating modes: Off: the SMA Power Balancer is deactivated. In the event of a device fault or grid voltage fault at an inverter, only this inverter is disconnected from the grid and the other two devices continue to run at an undiminished power level. PowerGuard: operating mode in which there is no distinction made between a device fault and a grid voltage fault. The relevant device disconnects itself from the grid, while the other two inverters limit their output to 5 kVA over a 10 minute average. PhaseGuard: operating mode in which a distinction is made between a device fault and a grid voltage fault. In the event of a device fault at the first Sunny Mini Central, the other two inverters continue to operate without reducing their output. In the event of a grid voltage fault, all devices immediately disconnect from the grid. FaultGuard: operating mode in which a distinction is made between a device fault and a grid voltage fault. In the event of a device fault, the fault message is sent to the other two devices with a delay of 5 minutes. After the 5 minutes have passed, the other two devices disconnect themselves from the grid. In the event of a grid voltage fault, all devices immediately disconnect from the grid.
Pmax	Output limitation of the inverter.
P-Wind-Mid P-Wind-Ramp	Parameters for adjusting the inverter in Turbine Mode. Further information on this topic can be found in the Windy Boy instruction manuals
Ripple-Ctl-Frq Ripple-Ctl-Lev Ripple-Ctl-Rcvr	The Ripple-Ctl-Frq, Ripple-Ctl-Lev, Ripple-Ctl-Rcvr parameters are intended to handle ripple control signals from the SMA inverters. These parameters are not available for all inverters. These parameters may only be changed after prior agreement with **SMA** Technologie AG.
Speicherfunktion Memory function	Default Parameter: returns all parameter values to the factory settings. Reset Betriebsdaten: returns all user-level parameter values to the factory settings. Reset Fehler: resets a permanent fault.

Name	Description
Storage Store	Permanent: modified parameters are stored in the EEPROM and can be used even when the inverter has been restarted. Volatile: prevents the parameters from being stored in the EEPROM, the parameters are only stored until the next restart.
T-Max-Fan	Temperature for the maximum fan speed.
T-Start	The period the inverter waits after the Upv-Start value has been reached.
T-Start-Fan	The fan starts to run at minimum speed at this temperature.
T-Stop	The period the inverter waits before disconnecting from the grid when P_{ac} drops below the set value.
T-Stop-Fan	If after a temperature increase the inverter cools down to below this threshold value, the fan switches itself off again.
Uac-Min Vac-Min Uac-Max Vac-Max	Lower (Uac-Min) and upper (Uac-Max) limits of the allowable AC voltage (self contained power system recognition), before the grid monitoring system disconnects the device from the grid.
UdcWindMax UdcWindMid UdcWindStart	Parameters for adjusting the inverter in Turbine Mode. Further information on this topic can be found in the Windy Boy instruction manuals
Upv-Start	The DC voltage required before the inverter begins feeding power into the grid. This value is above the minimum MPP voltage which is required in order to always guarantee safe connection to the grid, and to minimize grid relay wear. If, after disconnection from the grid, and in the absence of any further faults, the inverter does not automatically reconnect to the grid, this parameter can be decreased in small steps. It must be noted, that if the value is set too low, this leads to an increased number of connections to the grid, and thus to increased wear of components.
Usoll-Konst	PV desired voltage for constant operational voltage. These parameters are only important when the "Betriebsart" parameter is set to U-konst (V-Const).
Zac-Max	Maximum "grid impedance" before the grid monitoring system disconnects the device from the grid.

8.3.1 Non-modifiable parameters

The following parameters are displayed in the parameter list but cannot be changed:

Name	Description
Fac-Pderating	Frequency-dependent output limitation
Fac-Tavg	Averaging time of grid frequency gaging
Hardware-BFS	Hardware version of the operation control unit (BFR)
Plimit	Upper limit for AC output power
SMA-SN	Inverter's serial number
Software-BFR	Firmware version of the operation control unit (BFR)
Software-SRR	Firmware version of the current control unit (SRR)
Uac-Tavg	Averaging time of grid frequency gaging

8.4 Fault messages

If a fault develops, the Sunny Boys and Sunny Mini Centrals generate a message, the nature of which depends on the operating mode and the type of fault.

Fault code	Description
!PV-Overvoltage! !Disconnect DC !	Overvoltage at DC input. **Immediately disconnect the inverter from the PV generators! Otherwise, the inverter may be damaged.** Check the configuration of your system and measure the DC voltage before reconnecting the inverter to the DC voltage.
ACVtgRPro	The average grid voltage over 10 minutes is no longer within the permissible range. This can be due to either of the following reasons: • The grid voltage at the connection point is too high. • The grid impedance at the connection point is too high. The inverter disconnects to allow compliance with the voltage quality of the grid. Check the grid voltage at the connection point of the Sunny Boys and/or Sunny Mini Centrals. If, due to the local grid conditions, the grid voltage increases to 253 V or more, ask the electricity provider whether the voltage at the feed-in point can be adjusted, or whether they agree to an alteration of the threshold value ACVtgRPro (operating parameter: ACVtgRPro) for voltage quality monitoring. If the grid voltage is continuously within the acceptable range, yet the "ACVtgRPro" fault is still displayed, contact the SMA Serviceline.
Bfr-Srr	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
CAN	Internal communications fault. Contact SMA if this fault occurs frequently.
DCBFS-Startup	Internal communications fault. Contact SMA if this fault occurs frequently.
DC-A def.	A string input is faulty. Contact SMA if this fault is displayed.
DC-B def.	
DC-C def.	
DCBFS Version	DC-BFS has the wrong firmware version. Contact SMA if this fault is displayed.
Delta Bfr-Srr	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.

Fault code	Description
Derating	Once the inverter enters the "Derating" mode, it displays the "Derating" warning until the device is completely switched off (in the evening). Further information on this fault message can be found in chapter 4.4.7 "Derating" (Page 23).
dFac-Bfr dFac-Srr	The changes in grid frequency exceed the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). For reasons of safety, the inverter disconnects itself from the grid. If possible, check the grid frequency and check how often major deviations occur. If repeated frequency variations occur and this is causing "dFac-Bfr" or "dFac-Srr" faults, ask the electricity provider if they agree to a modification of the operating parameters (dFac-Max). Discuss the proposed parameters with the SMA Serviceline.
dI-Bfr dI-Srr	The inverter has detected a drastic change in the leakage current. This fault only occurs in transformerless inverters that have no galvanic isolation from the grid. The integrated leakage current monitoring is an important component for providing personal safety. The cause for a drastic change in the leakage current can be a sudden grounding fault, fault current or an actual fault in the device. The inverter disconnects itself from the grid. If the "dI-Bfr" or "dI-Srr" fault messages occur without obvious reason, consult a qualified electrician and ask them to check your system for correct insulation and a possible ground fault.
dI-Mess	Deviation in the leakage current measurement / leakage current. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
dI-Test	Fault in the leakage current measurement. Contact SMA if this fault occurs frequently.
dZac-Bfr dZac-Srr	The changes in grid impedance exceed the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). For reasons of safety, the inverter disconnects itself from the grid. If possible, check the grid impedance and check how often major deviations occur. If repeated frequency variations occur and this is causing "dZac-Bfr" or "dZac-Srr" faults, ask the electricity provider if they agree to a modification of the operating parameters (dZac-Max). Discuss the proposed parameter changes with the SMA Serviceline.

Fault code	Description
EEPROM	A data transfer fault occurred during reading or writing of data from the EEPROM, the data is not relevant for safe operation - this fault has no effect on performance.
EEPROM dBh	Data EEPROM is defective, the device has switched itself off because the loss of data has disabled important functions of the inverter. Contact SMA.
EeRestore	One of the duplicate data sets in the EEPROM is defective and has been reconstructed without loss of data.
Fac-Bfr Fac-Srr	The grid frequency is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). For reasons of safety, the Sunny Boy / Sunny Mini Central disconnects itself from the grid. Check the grid frequency and the grid connection on the inverter. If the grid frequency lies outside the permissible range because of local conditions, ask the electricity provider if they agree to a modification of the operating parameters (Fac-delta- and Fac-delta+). If the grid frequency lies within an acceptable range, yet "Fac-Bfr" or "Fac-Srr" faults are still being displayed, contact the SMA Serviceline.
Iac-DC_Offs-Srr	The DC component of the electricity fed into the grid is no longer within the permissible range. For reasons of safety, the inverter disconnects itself from the grid. If the grid current is outside the permissible range due to local grid conditions, contact the local electricity provider for assistance. If the grid current lies within the acceptable range, yet the "Iac-DC_Offs-Srr" fault is still being displayed, contact the SMA Serviceline.
IGBTs	The internal hardware monitoring has detected a fault in the power electronics. Contact SMA if this fault occurs frequently.
Imax	Overcurrent on the AC side. This fault code is displayed if the current in the AC network is larger than specified. Check your system configuration and the grid conditions.
Imax DC	Overcurrent in the DC circuit of the Sunny Boy Multi-String. The inverter is experiencing a current that lies above the specified value for the DC circuit. This is caused by excessive current on the DC input. Check your system configuration.

Fault code	Description
K1-Schliess K1-Close K1-Trenn K1-Open K2-Trenn K2-Open	Fault during relay test. Please contact SMA if this fault occurs often or repeatedly.
Kom DC-BFS	Internal communications fault. Contact SMA if this fault occurs frequently.
L<->N	L and N are swapped on the AC connection. Ask an installation engineer to check the system.
L-Netz	A grid relay is faulty. The inverter checks the relays connecting it with the grid before feeding power into the grid. If the relays are not functioning correctly, the disconnection from the grid may not work properly, so the inverter does not connect to the grid. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
L-WR	A grid relay is faulty. The inverter checks the relays connecting it with the grid before feeding power into the grid. If the relays are not functioning correctly, the disconnection from the grid may not work properly, so the inverter does not connect to the grid. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
MWE Defekt DC Meas DC	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.

Fault code	Description
N-Netz	A grid relay is faulty. The inverter checks the relays connecting it with the grid before feeding power into the grid. If the relays are not functioning correctly, the disconnection from the grid may not work properly, so the inverter does not connect to the grid. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
N-WR	A grid relay is faulty. The inverter checks the relays connecting it with the grid before feeding power into the grid. If the relays are not functioning correctly, the disconnection from the grid may not work properly, so the inverter does not connect to the grid. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
NUW-dI	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
NUW-FAC	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
MSD-Fac	
NUW-UAC	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
MSD-Vac	
NUW-Timeout	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
MSD-Timeout	
NUW-ZAC	Internal measurement comparison fault or hardware defect. Contact SMA if this fault occurs frequently.
MSD-Zac	
Offset	Fault in the acquisition of measurement data. Contact SMA if this fault occurs frequently.

Fault code	Description
PowerBalance	The Sunny Mini Central is part of a three-phase system with two further Sunny Mini Centrals and equipped with the SMA Power Balancer for prevention of unbalanced loads. The operating parameter "PowerBalancer" is set to "PhaseGuard" or "FaultGuard". In the "PhaseGuard" operating mode, one of the three Sunny Mini Centrals in this system has detected a grid fault, and disconnected itself from the grid. The two other inverters receive a message and for a short period display the "PowerBalance" fault, before switching to "Balanced" status. In the "FaultGuard" operating mode, one of the three Sunny Mini Centrals in this system has detected either a device fault or a grid fault, and disconnected itself from the grid. In the event of a device fault, the two other inverters receive the fault message after a delay of 5 minutes, then for a short period display the "PowerBalance" fault, before switching to "Balanced" status. In the event of a grid fault, the two other inverters immediately receive a fault message and for a short period display the "PowerBalance" fault, before switching to "Balanced" status (more information on the "Balanced" status can be found in chapter 8.2 "Status messages" (Page 46)).
Rechner MSD-Timeout	Functional fault in one of the two microcontrollers. Please contact SMA if this fault occurs often or repeatedly.
Relais 1 Relais 2 Relais 3 Relais 4	A grid relay is faulty. The inverter checks the relays connecting it with the grid before feeding power into the grid. If the grid relays do not function properly, the inverter cannot connect itself to the grid. If this fault occurs repeatedly, the inverter indicates a permanent restriction of operation. You can attempt to remove the fault with the aid of a communication interface and the corresponding communication product (e.g. PC with Sunny Data or Sunny Boy Control). If this is unsuccessful, consult the Sunny Boy Serviceline to discuss further action.
Riso Erdschluss Earthfault	The electrical insulation between the PV system and ground is faulty. The resistance between the DC plus and/or DC minus connection and the ground is outside the defined limit range. Have a qualified electrician check your system for correct insulation and a possible ground fault.
ROM	The inverter's firmware is faulty. Contact SMA if this fault occurs frequently.

Fault code	Description
SD-DI-Wandler	The inverter has detected an insulation fault on the DC side. Have a qualified electrician check your system for correct insulation and a possible ground fault.
SD-Imax Overcurrent	The inverter has detected an overcurrent on the AC side. It disconnects itself from the grid for safety reasons, then attempts to reconnect itself to the grid. Contact SMA if this fault occurs frequently.
SD-WR-Bruecke	The inverter has detected a fault in the power electronics. It disconnects itself from the grid, then attempts to reconnect itself to the grid. Contact SMA if this fault occurs frequently.
Shutdown	Temporary inverter fault.
Trafo-Temp-F	The transformer has reached an unacceptably high temperature. The inverter stops feeding the grid until the temperature lies within the acceptable range. If this fault occurs frequently, check the heat dissipation of the device.
Trafo-Temp-W	If the transformer reaches an unacceptably high temperature, the inverter stops feeding the grid until the transformer has reached an acceptable temperature and the system can begin feeding the grid again. The Trafo-Temp-W warning is displayed until the next time the device is completely switched off (at the end of the day). Check the heat dissipation of the inverter.
Uac-Bfr Vac-Bfr Uac-Srr Vac-Srr	The grid current is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). The Uac fault can have the following causes: • Grid disconnected (circuit breaker or fuse) • Broken AC cable or • AC cable has a high internal resistance For reasons of safety, the inverter disconnects itself from the grid. Check the grid current and the grid connection on the inverter. If the grid voltage lies outside the acceptable range because of local grid conditions, ask the electricity provider if the voltage can be adjusted at the feed-in point or if they agree to changes in the values of the monitored operational limits (operating parameters: Uac-Min and Uac-Max). If the grid voltage lies within an acceptable range, yet "Uac-Bfr" or "Uac-Srr" faults are still being displayed, contact the SMA Serviceline.

Fault code	Description
UDiff	Fault in intermediate circuit. Contact SMA if this fault occurs frequently.
Upv-Max	Overvoltage at DC input. **Immediately disconnect the inverter from the PV generators! Otherwise, the inverter may be damaged.** Check the configuration of your system and measure the DC voltage before reconnecting the inverter to the DC voltage.
Uzkposneg<10	Fault in auxilliary circuit. Contact SMA if this fault occurs frequently.
UZWK-Max	The internal hardware monitor has detected an overvoltage condition in the intermediate circuit of the inverter. Contact SMA if this fault occurs frequently.
Watchdog Watchdog-Srr	Fault in the program code flow monitoring
Zac-Bfr Zac-Srr	The grid impedance is no longer within the permissible range ("Bfr" or "Srr" is an internal message that has no meaning for the user). For reasons of safety, the inverter disconnects itself from the grid. The impedance is calculated from the grid impedance and the impedance of the grid connection cable (AC cable) of the inverter. Check the grid impedance and grid connection on the inverter. Use a grid connection cable with an adequate cross section (= low impedance), observe the advice to this effect in the installation manual. This fault may also be rectified by tightening the AC fuse. If the fault continues to occur, contact SMA to discuss further action.

9 Glossary

AC

Abbreviation for "Alternating Current"

Central inverter

An inverter concept, in which all PV modules are connected to each other (in series and/or parallel) and which uses a single inverter for feeding energy into the external grid.

DC

Abbreviation for "Direct Current"

Derating

A controlled reduction in performance, usually dependent on component temperatures. Compared with the normal process of completely shutting down the device, the effect on the external power network is smaller with derating.

Grid-coupled system

A PV system that is connected to the supply grid of an external energy supplier.

Grid impedance

The grid impedance is a characteristic grid specification, which is determined by the grid's infrastructure, as well as by the number of power suppliers and power consumers. If supply to the grid section drops out due to a grid shutdown on the part of the adjacent supplier (medium voltage transformer), the grid impedance changes abruptly. In order to detect this occurrence, and to prevent an unwanted stand-alone grid, SMA grid guard measures the grid impedance and disconnects the inverter from the grid in the event of a jump in impedance.

Inverter

A device for converting the direct current (DC) from the PV generator into alternating current (AC), which is used by most normal household devices and especially for feeding energy into an existing supply grid. Inverters for PV systems usually contain one or more MPP trackers.

Maximum Power Point "MPP"

The operational point (current / voltage) of the PV generator at which the highest possible performance under the prevailing conditions is achieved. The actual MPP changes constantly depending (e.g.) on the level of solar irradiation and the cell temperature.

MPP tracker

A device that adjusts the voltage and current of a PV generator so that it is operated at its "Maximum Power Point". The "Maximum Power Point" is the operating point with the maximum power output.

Multi-String inverter

An inverter that combines the advantages of several string inverters (separate MPP trackers for the individual strings) and a central inverter (lower performance-specific costs).

NLM

Abbreviation for "Netzleitungsmodem" (Powerline modem). The communication between SMA inverters and the monitoring devices can be made with a cable or wireless link, but also via grid communication. In the NLM system, a carrier frequency of approx. 132 kHz is modulated onto the AC cables, and the data is then transferred using FSK ("Frequency Shift Keying") of this carrier signal. Details on the NLM can be found (e.g.) in the technical description of the SWR-COM.

PLC

Abbreviation for "Powerline Communication", describes the process of data transfer over the grid supply cables. The PLC power module is used to amplify the signal and is installed in Multi-String inverters and Sunny Mini Centrals SMC 5000 and SMC 6000.

PV

Abbreviation for "Photovoltaic", describes the conversion of solar energy into electrical energy.

PV generator

Technical device for the conversion of light energy into electrical energy. This normally also describes all installed and electrically connected solar modules in a PV system.

PV module

A collection of individual solar cells in an enclosure that protects the sensitive cells from mechanical stresses and allows easy installation.

PV system

Describes the complete collection of components needed for the acquisition and utilization of solar energy. As well as the PV generator, this also includes the Sunny Boy or Sunny Mini Central, for example, in the case of grid-coupled systems.

SMA grid guard

Part of an "independent disconnection device for electrical power units". This is a mandatory safety device that prevents power from a solar energy system being fed into a deactivated grid when the external power generators are not functioning. In the Sunny Boy / Sunny Mini Central, this function is assumed by the "SMA grid guard".

SMA Power Balancer

The SMA Power Balancer refers to a circuit connection of three Sunny Mini Centrals to a 3-phase low-voltage grid. This circuit connection is used to prevent unbalanced loads between two phases as specified by the "electrical power units on the low-voltage grid" VDEW guideline.

The installation engineer can use the "PowerBalancer" parameter to stipulate whether, in the event of an inverter fault, an unbalanced load is to be avoided by deactivation of the other two inverters, or by limiting their power to an average of 5 kVA over 10 minutes.

Solar cell

An electronic component that generates electrical energy when irradiated with sunlight. Since the voltage produced by a solar cell is very small (approx. 0.5 V), several solar cells are combined to form a solar module. The most common material presently used for solar cells is silicon, which is manufactured in different forms (monocrystalline, polycrystalline, amorphous). In addition to different mechanical variations, that are usually designed to increase the level of efficiency, completely new materials are currently being tested (cadmium telluride, cadmium indium sulphide, titanium dioxide and many others.)

Solar energy

"Sun energy", i.e. energy from sunlight (solar radiation).

Solar module

A collection of individual solar cells in an enclosure that protects the sensitive cells from mechanical stresses and allows easy installation.

Stand-alone grid system

An energy generation system that is completely independent of any external grid.

String

Describes a group of solar modules electrically connected in series.

String inverter

An inverter concept that avoids the disadvantages of the central inverter concept. The PV generator is split into individual strings, each of which feeds the grid by means of its own string inverter. This greatly simplifies installation, and the yield losses caused by manufacturing deviations or variations in shadowing of the solar modules are greatly reduced.

Unbalanced load

The difference between the power fed into the grid at the individual phase conductors. In Germany, this is not permitted to exceed a rated output of 4.6 kVA (plus 10 % overload, so in total 5 kVA).

Varistor

In the Sunny Boy and Sunny Mini Central, the varistors serve to guard against atmospheric overvoltages, e.g. nearby lightning strikes. They divert overvoltages in order to protect the electronics in the Sunny Boy or Sunny Mini Central. During operation, varistors are subject to a certain degree of ageing. Varistors which have already been operating for a considerable period of time, or have already needed to divert overvoltages, become highly resistive. Thermally monitored varistors detect increased temperature (which suggests such "ageing"). If one of the varistors is no longer functional, the inverter triggers a fault message.

10 Contact

If you have any questions or technical problems concerning your inverter, please contact our Serviceline. Have the following information available when you contact SMA:

- Inverter type
- Communication method
- Type and number of modules connected
- Inverter's serial number
- Inverter's blink code or display

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- Operating the product whilst ignoring relevant, statutory safety regulations in the deployment location
- Ignoring safety warnings and instructions contained in all documents relevant to the product
- Operating the product under incorrect safety or protection conditions
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- The product malfunctions due to operating attached or neighboring devices beyond statutory limit values
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